

PATENT  
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TITLE: PORTABLE INFORMATION DEVICE, ACCESS  
DEVICE FOR PORTABLE INFORMATION DEVICE,  
HOME NETWORK SYSTEM, AND HOME NETWORK  
ACCESS METHOD

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PORTABLE INFORMATION DEVICE, ACCESS DEVICE FOR PORTABLE  
INFORMATION DEVICE, HOME NETWORK SYSTEM, AND HOME NETWORK  
ACCESS METHOD

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a portable information device associated with a home network. More particularly, the present invention relates to a portable information device contributing to the mutual use of the resources of the portable information device and the home appliances connected to a home network.

2. Description of the Related Art

A network connecting to home conventionally meant ground-based TV broadcastings and phone lines over ten years ago. Also, a home network had meant nothing but connection between the TV and VTR or between audio devices because personal computers (PCs) and digital products including a CD player had not been spread home then.

However, the home network has rapidly come to be in the spotlight recently, exploiting the Intranet technology, which has been developed for business use, such as LAN.

The rapid popularization of information devices such as a PC, a printer, and a scanner and the sharp increase of

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the number of Internet users as well as the diversification of communication and broadcasting services contribute to the progress of the home network. Besides general phone lines, various kinds of communication means such as ISDN line, cellular phone, and PHS have been developed. To add to the ground-based broadcasting, other broadcasting services such as BS and CS analogue broadcastings, CATV, and digital CS broadcasting are being launched. In the audiovisual (AV) industries, digital products such as a MD player, a digital video camera, and a digital still camera have rapidly progressed, expecting that digital videos and digital TVs will further develop. Also, the technology has been introduced that allows home appliances such as a refrigerator, an air conditioner and a microwave oven to be connected to a home network and allows these connected appliances to be remotely operated and maintained.

In the industry of communication devices, it is no wonder any more that cordless phones are used, and mobile communication devices such as a cellular phone and a PHS have remarkably progressed. Personal digital assistants (PDAs) used as personal information management tool also increases in the number of users. A hand-held terminal containing a communication device such as a cellular phone or a PHS appears to serve as e-mail or personal information manager (PIM).

Thus, the portable information devices such as a cellular phone and PDAs have remarkably progressed as well as the home network. The use of portable information devices is however limited to out-of-home uses such as phone calling, data communication, and schedule management, and is isolated from home appliances. Resources and units on a portable information device, such as operation and display units, therefore are not usable for the home network.

Portable information devices such as a cellular phone and PDAs are independently operated on themselves, not intended to be operated by external equipment. If the portable information devices, which are progressing in personalization, share resources of external equipment, they can be exploited effectively.

#### SUMMARY OF THE INVENTION

The present invention has been achieved to obviate these and other shortcomings of the related art. It is therefore an object of the present invention to enable house use of resources, operation and display units, and so on that together are available on a portable information device such as a cellular phone or a PDA.

It is another object of the present invention to allow a portable information device to be effectively associated with a home network, so that information provided by

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appliances connected to a home network can be used on a portable information device.

Accordingly, the present invention intends to make the home network accessible from a portable information devices such as a cellular phone and PDAs. Hence, using a personalization-oriented portable information device leads to the personalization of the operation of home appliances connected to the home network, thereby providing a solution to the problem that the manner of use of home appliances is different depending on individuals. To this end, according to one aspect of the present invention, there is provided a portable information device comprising initialization data transmitting means for transmitting initialization data to an access point connected to a home network networking home appliances. The portable information device further comprises response data receiving means for receiving response data responsive to the initialization data from the access point. An operational information transmitting means are provided for transmitting information used to operate a home appliance connected to the home network after the response data receiving means has received the response data.

The operational information transmitting means may transmit identity information, such as URL, for identifying the home appliance to select it from among home appliances connected to the home network, so that the communication

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with the selected home appliance become available.

Pursuant to another aspect of the present invention, there is provided an access device connected to a home network and serving as an access point to permit an access to the home network from a portable information device. The access device comprises a network interface for accessing a home network of home appliances to communicate with each of the home appliances. A portable information device interface is provided for communicating with the portable information device. Control means including a CPU and a memory device are provided for negotiating with the portable information device via the portable information device interface. Data are transmitted between the portable information device and each of the home appliances through the portable information device interface and the network interface after the negotiation by the control means.

The control means may determine whether data received from the portable information device interface are valid. When the data are valid, the control means determine whether the data are an initialization packet. When the data are an initialization packet, the control means newly creates an initialization packet and outputs the new initialization packet to the portable information device interface. A communication path is thus established after the negotiation to confirm, for example, matching of the protocol between

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the portable information device and the home appliance.

The control means may be arranged to analyze data derived from the portable information device interface and to deliver the data to the network interface after a protocol conversion. Such an arrangement advantageously permits home appliances connected to the home network to be operated by means of resources of the portable information device.

Preferably, the arrangement is such that the control means determine whether data received from the network interface are valid for accessing the portable information device. When the data are valid, the control means create a transfer packet and output it to the portable information device interface, thus enabling the portable information device to use resources of home appliances connected to the home network.

Pursuant to still another aspect of the present invention, there is provided a home network system comprising a home network for networking a plurality of home appliances. The home network system comprises a portable information device connectable to the home network in a wireless manner. An access point is provided for reciprocal data communication between the home appliances connected to the home network and the portable information device. The portable information device does negotiation to be served by

the access point.

The portable information device may be arranged such that it transmits to the access point the data used to select a home appliance from among a plurality of the home appliances after the negotiation. Hence, a plurality of the home appliances connected to the home network are used as servers, so that designating the URL of a desired home appliance in a WWW-accessing manner provides communication with the designated home appliance.

According to a methodological aspect of the present invention, there is provided a method for accessing a home network for networking a plurality of home appliances. The home network access method comprises receiving from a portable wireless information device a request for accessing the home network. The home network access method further comprises recognizing, upon receipt of the request for access, an address for designating a home appliance with which the portable wireless information device will communicate. The home network access method is capable of exchanging data between the home appliance designated by the recognized address and the portable wireless information device.

According to another methodological aspect of the present invention, there is provided a method for accessing a home network networking a plurality of home appliances.

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The home network access method comprises transmitting a request for accessing the home network to an access point connected to the home network. The home network access method comprises transmitting address information used to designate a home appliance included in the home network after the transmission of the request for access. Transmitting, after the transmission of the address information, operational information used to operate the home appliance is included in the home network access method.

A program implementing each method of the present invention may be installed in the portable information device via the Internet by a program transmission device. In this case, the program transmission device may be a computer that comprises a storage device and a transmission device for transmitting the program read from the storage device thereby. The storage device is provided for storing the program for executing: a step of transmitting a request for accessing the home network to the access point connected to the home network; a step of transmitting an address information to select a certain home appliance networked by the home network after the transmission of the request for access; and a step of transmitting information used to operate the selected home appliance after the transmission of the address information. Installing the program through the Internet, therefore, allows even the portable

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information device that did not previously have a function for accessing the home network to obtain and store the function.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagrammatical representation of an overall configuration of a home network used in an embodiment of the present invention;

Fig. 2 is a diagram showing an internal configuration of a portable information device access point ;

Fig. 3 is a flowchart of the operation of a CPU in the portable information device access point;

Fig. 4 is a flowchart of the operation of the CPU 35 in the portable information device access point;

Fig. 5 shows an example of packets flowing on the home network according to an embodiment of the present invention; and

Fig. 6 is a diagram showing another configuration of the home network.

#### DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention will be described in detail according to embodiments viewed in drawings. FIG. 1 shows an overall configuration of a home network of an embodiment. The home network system generally includes a low-speed

network system 10 in which home electric appliances are connected, a high-speed network system 20 in which home audiovisual devices and the like are connected, and a bridge 9 for interconnecting the low-speed and the high-speed network systems. A gateway may be provided instead of the bridge 9. The bridge 9 or the gateway contributes to converting formats of messages and character codes and exchanging address structures varying from network to network, protocols used at various layers, and so on.

The low-speed network 10 for home electric appliances is networked by the low-speed network 11. The low-speed network 11 connects a bath control unit 12 for controlling temperature of supplied bath water and a water level of a tub, a lighting controller 13 of room lights, air-conditioning equipment 14 such as an air conditioner, cooking appliances 15 including a microwave oven and a refrigerator, and security sensors 16 including sensors for funding burglary, gas leakage, and frequency in the use of home appliances. These units, controllers, equipment, appliances, and sensors and others are also referred to collectively as home appliances. Some multipurpose systems for the low-speed network 11 that allow various home appliances to be easily controlled are studied. For example, Echonet Consortium and HomePlug<sup>TM</sup> have been standardizing such systems.

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The high-speed network system 20 including home audiovisual devices is networked by a high-speed network 21 based on a technical standard such as Ethernet. The high-speed network connects digital recorders 22 for the use of digital recording, such as a digital film recorder, a digital voice recorder, and a digital video recorder, a personal computer (PC) 23, an audio system 24, a digital TV 25, and a security camera 26 for watching over an entrance or a specific place. These digital devices, PC, audio system, security camera and so on are also referred to collectively as home appliances. The high-speed network 21 also connects a portable information device, such as a cellular phone and a personal digital assistant (PDA), and an access point 30 used as an access device for the portable information device 40. The access point is connected in a wireless or wired manner and exchanges data with the portable information device 40. When a home appliances connected to the high-speed network 21 is controlled, Hypertext Transfer Protocol (HTTP), which is described in Request For Comments 2068 (RFC2068), is used as server protocol, so that the home appliance can take advantage of the technology of World Wide Web (WWW). In this network mentioned above, the bridge 9 is used as HTTP server.

A portable information device 40 as typified by a cellular phone is intended to use for calling and

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communicating data outside. The portable information device 40 is constantly connected to public infrastructures, thereby charged for the connection. On the other hand, the portable information device 40 of this embodiment can be directly connected to a home network via the access point 30, not a public infrastructure. The communication between the portable information device 40 and home appliances therefore is not charged.

In this communication, an Internet protocol (IP) or other exclusive protocol helps data transmission, such as packet transmission, between the access point 30 and the portable information device 40. Thereby, the portable information devices 40 can communicate with various home appliances including home audiovisual devices connected to the high-speed network 21 and home electric appliances connected to the low-speed network 11. When the portable information device 40 accesses the access point 30, the access point 30 receives information from the home appliances connected to the high-speed network 21 and/or the low-speed network 11 and returns the information to the portable information device 40. The portable information device 40 that received the information selects a home appliance from among the home appliances connected to the home network according to the received information, thus starting to operate the selected home appliance.

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FIG. 2 shows an internal configuration of the portable information device access point 30. The access point 30 comprises through buses 31 a network interface 32, a wireless device 33 used as interface for portable information devices 40, and controlling means including a memory device 34 and a CPU 35. The network interface 32 is connected to the high-speed network 21 and transmits protocol data to and from the home appliances or the like. The wireless device 33 transmits data to and from the portable information device 40 with packets or the like. If the access point 30 is physically connected through wire to, for example, the portable information device 40, the wireless device 33 serves as connection interface. The memory device 34 works for temporarily storing protocols received from the high-speed network 21 and the portable information device 40. The CPU 35 analyzes data received from the network interface 32 and the wireless device 33. When the network interface 32 and the wireless device 33 have different transmission rates or different protocols each other, the CPU 35 routes the data and/or converts the protocols by using the memory device 34. Thus the CPU 35 enables the network interface 32 and the wireless device 33 to bidirectionally transmit data.

For example, when the portable information device 40 such as the cellular phone or the PDA accesses the lighting

controller 13 included in the low-speed network system 10 and controls on-off action of lights, the portable information device 40 does negotiation to be served by the access point 30. After the negotiation, communication packets are transmitted via the access point 30 from the portable information device 40 to the high-speed network 21.

When the portable information device 40 accesses the bridge 9, it designates the URL like "Bridge" in a WWW-accessing manner. This designation of the URL permits the portable information device 40 to access the bridge 9. When the high-speed network system 20 accesses the bridge 9 with HTTP, the bridge 9 recognizes or checks home appliances connected to the low-speed network 11 by means of a protocol such as Echonet or HomePlugor and determines what home appliances are currently available. The determination result is transmitted to the portable information device 40 via the access point 30, expressed by Hypertext Markup Language (HTML), HTML2 (RFC1866), HTML4 (ISO8879), or the like.

The bridge 9 having a function for converting protocols of the high-speed network system 20 and the low-speed network system 10 allows the portable information device 40 to realize various applications. The applications includes, for example, controlling on-off and lighting of room lights, setting air-conditioner, supplying bath water, checking

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statuses of security sensors such as a door lock sensor, break-in sensor, and in-existence sensor, operating security equipment such as door lock, transmitting data to cooking appliances including a microwave oven, operating appliances, and indicating statuses.

Besides the bridge 9, the home appliances connected to the high-speed network 21, such as digital recorder 22, the personal computer 23, the audio system 24, the digital TV 25, and the security camera 26, are operated by the portable information device 40, if these home appliances have the function as HTTP server. Hence, accessing in a www-accessing manner, the portable information device 40 operates each home appliance having URL and indicates the status of each home appliance.

FIG. 6 illustrates another configuration of the home network of the embodiment shown in FIG. 1. The home network of this embodiment comprises IEEE1394 bus 7 connected via a bridge 8 to the high-speed network 21 as typified by Ethernet. The IEEE1394 bus 7 connects home appliances meeting IEEE1394 standard, such as the digital TV 25, the audio system 24, and the digital recorder 22. The IEEE1394 bus is available to some restricted applications including audiovisual devices. IEEE1394, a high-speed digital serial interface standardized internationally, has now three types of transmission rates, 100 Mbps, 200 Mbps, and 400 Mbps,

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further planed to normalize the rate of 800 Mbps and more. IEEE1394 employs the isochronous transfer mode for transferring preferentially sounds and animation. IEEE1394 contributes to power supply through its bus and allows each home appliance to be directly connected with other devices without any host such as a PC, thus being used as infrastructure for the home network for networking the audiovisual devices of this embodiment. Hence, IEEE1394 allows the portable information device 40 to operate each home appliance connected to the IEEE1394 bus and to indicate the status of the home appliance. The portable information device 40 accesses, in a WWW-accessing manner, home appliances connected to the IEEE1394 bus 7 via the bridge 8 as well as home appliances connected to the low-speed network 11 via the bridge 9.

FIG. 3 and FIG. 4 show flowcharts of operations of the CPU 35 in the access point 30. FIG. 3 and FIG. 4 respectively illustrate the case of interruption by the wireless device 33 and the case of interruption by the network interface 32. The CPU 35, first, does negotiation to check whether the protocol of the portable information device 40 corresponds with that of the access point 30. For example, when the portable information device 40 communicating by wireless enters an area where it can communicate with the access point 30, the CPU 35 determines

When the CPU 35 is interrupted by the network interface 32, as shown in FIG. 4, it determines whether the packet itself is available, or whether the data of the packet are

valid (step 111). If the data are invalid, the process is finished. Otherwise, the CPU 35 determines whether the packet means an initialization packet (step 112). If the packet is the initialization packet, a new initialization packet is created (step 113) and transmitted to the network interface 32 (step 114), and then the process is finished. If the packet does not mean the initialization packet, the packet is determined whether it is to be transmitted to the access point 30 (step 115). If so, a packet for returning internal processing is created (step 116) and transmitted to the network interface 32 (step 117), so that the packet for returning to home appliances included in the home network system is transmitted. If the packet is not to be transmitted to the access point 30, a transmission packet is created (step 118) and transmitted to the wireless device 33 (step 119), so that data are transmitted to the portable information device 40 from home appliances included in the home network system. In this embodiment, the CPU 35 determines whether data are valid in the case of the interruption by the network interface 32 as well as in the case of the interruption by the wireless device 33. Thus, the access point 30 appropriately deals with such problems noise breaks out in a packet or that a plurality of home appliances request for data transmission at the same time.

FIG. 5 shows an example of a series of packets flowing

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on the home network of this embodiment. In the series of packets, a SYNC signal for synchronizing is transferred following a preamble, and then destination and source addresses to and from which packets are transmitted. Then, user data and a frame check sequence (FCS) are transmitted in order. The user data include command codes specifying data types, data status, user data being actual data, a check sum for dealing with errors in the user data, and request codes for specifying requirements between the portable information device 40 and the home network system.

This embodiment allows the portable information device as typified by a cellular phone to access the high-speed network system 20 with and/or without wire, not served any public circuit. Therefore the resources and operation and display units that together are provided in the portable information device 40 are available in the house. Directly connecting the portable information device 40 to the high-speed network system 20 in the house contributes to the home network without using public infrastructure.

When resources included in the home network system are mutually used between the home network and portable information device, only the desired home appliance and network are selected through recognizing or certifying each of the home network and portable information device and the network. Unnecessary home appliances and network are

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rejected as well.

Another embodiment of this invention may be configured such that the portable information device 40 on standby or sleep automatically ups and runs to execute necessary processes according to a request for connection and then returns to standby or sleep. This configuration allows the home appliances connected to the home network to use and operate the resources of the portable information device 40 without regard to the state of the portable information device 40.

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